Detailed

Area North of I-10 (northern impoundments)

Summary of the Baseline Ecological Risk Assessment

The BERA for the area north of I-10 (also, northern impoundments) and aquatic environment (Integral 2012) builds on the CSMs described in the PSCR and uses Category 1 baseline data and background data collected in support of the RI/FS to determine the nature and magnitude of baseline risks to ecological receptors resulting from exposures to $COPC_E$s. The BERA for the area south of I-10 is (also, southern impoundment) is presented separately below. This section provides a summary of the major components of the BERA for the area north of I-10 impoundments and aquatic environment within USEPA's Preliminary Site Perimeter, including the problem formulation, exposure and effects assessments, and risk characterization, all of which support the risk assessment conclusions and identification of ecological COCs.

Problem Formulation

$COPC_E$s for the area north of I-10 and aquatic environment were determined using the RI dataset according to methods specified in Appendix C of the RI/FS Work Plan (Anchor QEA and Integral 2010a) and the COPC Tech Memo (Integral 2011a). $COPC_E$s were subdivided into those of concern to benthic invertebrates and those of concern to fish and wildlife (Table 1-2 [from the RI Report, already listed above in HH section] and Table 3-1 [from the BERA] for COPCs specific to the northern impoundments). $COPC_E$s for wildlife and fish are those that exceed screening levels and those for which screening levels are not available but that may be considered bioaccumulative. $COPC_E$s for benthos are those lacking benthic screening levels, and those that exceed screening values at one or more sediment sampling stations. All of the $COPC_E$s have some potential to adversely affect the survival, growth, and/or reproduction of one or more ecological receptors if exposures are sufficiently elevated. Information about the types of effects associated with each $COPC_E$ in various species, and the information used to interpret exposure estimates for ecological receptors is provided in Appendix B to the BERA for the area north of I-10 and aquatic environment.

In the context provided by the CSM for the area north of I-10 and aquatic environment (Figure 1-1 from the BHHRA [already listed above]), the BERA for the area north of I-10 and aquatic environment evaluates the following ecological receptors and exposure pathways:

- The benthic macroinvertebrate community exposed through direct contact with the benthic environment (sediment and porewater)
- Bivalve molluscs exposed to 2,3,7,8-TCDD through direct contact with the benthic environment (sediment, porewater, and surface water), using tissue concentrations in whole clams as the measure of exposure
- Fish (in all feeding guilds) exposed through ingestion of sediment and food, and respiration of water
- Reptiles exposed through ingestion of sediment or soils, water, and food
- Birds (in all feeding guilds) exposed through ingestion of sediment or soils, water (for

seabirds only), and food
- Mammals exposed through ingestion of sediment or soils and food.

Wildlife listed as threatened and endangered are also considered by using surrogate species. Surrogate species chosen for the BERA are provided in Table 3-9 [of the BERA], and the lines of evidence used for each receptor and assessment endpoint are summarized in Table 3-11 (of the BERA) for the area north of I-10 and aquatic environment. Life History parameters used in exposure modeling are provided in Table 3-12 [of the BERA].

To the maximum extent possible, empirical site-specific data were used to compute the EPCs for each of the measures of potential exposure described above. Data collected within USEPA's Preliminary Site Perimeter and from background areas that make up the baseline dataset. In some cases, modeling was required to derive exposure concentrations. Models were used to estimate $COPC_E$ concentrations for the following:

- Surface water concentrations of those $COPC_E$s for which empirical data are not available and for which estimates were needed
- Terrestrial invertebrate prey and plant foods ingested by killdeer, marsh rice rat, alligator snapping turtle, and raccoon
- Concentrations of dioxin, furan, and dioxin-like PCB congeners in bird eggs.

Exposure Assessment

Exposure pathways classified as complete and significant were quantitatively addressed in the BERA for the area north of I-10 and aquatic environment. Several lines of evidence were used to evaluate risk for each assessment endpoint:

- For benthic macroinvertebrates
  - Comparison of bulk sediment concentrations of each $COPC_E$ to literature-based benchmarks or toxicity reference values (TRVs) expressed as a concentration in sediment; this was the primary line of evidence used for all $COPC_E$s
  - Comparison of estimated concentrations of each $COPC_E$ in porewater to literature-based benchmarks or TRVs expressed as a concentration in water
  - For dioxins and furans only
    - Comparison of the concentration of 2,3,7,8-TCDD in tissue of whole clams to critical tissue residues (CTRs) expressed as a concentration in tissue of molluscs
    - Comparison of the concentration of 2,3,7,8-TCDD in sediments with a no observed adverse-effects level (NOAEL) for sediment
- For fish, at least one of the following lines of evidence was evaluated for each receptor–$COPC_E$ pair depending on the data available
  - Comparison of $COPC_E$ concentrations in the ingested media of fish to a TRV expressed as a concentration in food (Table 4-7 [from BERA])
  - Comparison of estimated concentrations of $COPC_E$s in surface water to literature-based TRVs or benchmarks expressed as a concentration in water (used when TRVs expressed as concentrations in ingested food were not available)

  - Comparison of the concentrations of total PCBs, $TEQ_{DF,F}$, and $TEQ_{DFP,F}$ in tissue of whole fish to CTRs expressed as a concentration in fish embryos (Tables 4-5 and 4-6 [from the BERA])
- For reptiles and mammals
  - Calculation of an individual's cumulative daily ingested dose of each $COPC_E$, expressed as mg $COPC_E$/kg body weight (bw) per day (mg/kg bw-day), and comparison of this estimate to a TRV expressed in the same terms
- For birds, the line of evidence above was used in addition to the following second line of evidence
  - Calculation of the $TEQ_{DF,B}$ and $TEQ_{P,B}$ concentration in bird eggs (ng/kg egg, ww), and comparison to TRVs expressed in the same terms.

Except for the calculation of daily ingestion rates (Table 4-13 from BERA) of dioxins and furans by birds, wildlife exposure calculations for all $COPC_E$s conservatively assume that bioavailability in all media ingested in the field is the same as in the laboratory toxicity study that provides the basis for the TRV. For dioxin and furan ingestion by birds, a literature-based relative bioavailability factor was used to adjust the rates of absorption from 2,3,7,8-TCDD in soils, sediments, and invertebrates in the diet of avian receptors (Table 4-9 [from the BERA]). The risk characterization was completed both with and without the adjustment factor in order to evaluate its impact on the risk assessment.

For receptors whose estimated exposure for one or more $COPC_E$s exceeded the lowest observed-adverse-effects level (LOAEL) in the deterministic exposure assessment, subsequent analyses included probabilistic exposure evaluation, evaluation of post-TCRA exposure, and consideration of background exposures to $COPC_E$s. Probabilistic exposure assessment used assignment of probability distributions to certain exposure parameters including EPCs (Table 4-21 [from the BERA]), body weight, feeding weight, and rates of ingestion of prey and abiotic media, to yield a probability distribution for $COPC_E$ exposure. Exposure distributions were developed for each relevant receptor–$COPC_E$ pair.

Effects Assessment

Lines of evidence in the BERA for the area of investigation north of I-10 and aquatic environment employ both TRVs (Tables 5-1 through 5-4 from BERA), which are used to denote conservative no-effects/effects thresholds for survival, growth, and reproduction of individuals; and benchmarks such as the AWQC, considered protective of a broader group of taxa (e.g., aquatic macroinvertebrates or aquatic communities). Detailed information on the methods used and data considered in selection or derivation of NOAEL and LOAEL TRVs and benchmarks are provided in Appendix B to the BERA for the area north of I-10 and aquatic environment. The effects of $COPC_E$s were assessed through comparison of chemical concentrations in environmental media to chemical- and medium-specific TRVs or, for exposure assessments involving estimates of ingested dose, comparison of the dose to a chemical-specific TRV expressed in the same terms (mg/kg bw-day).

Risk Characterization and Uncertainty Analysis

The BERA for the area north of I-10 and aquatic environment uses a tiered approach to the

analysis and characterization of risks under baseline conditions. Initially, assessment of risk was performed using a deterministic model for each receptor and each $COPC_E$ to which that receptor may be significantly exposed via a major exposure pathway, resulting in an HQ for each receptor–$COPC_E$ pair. HQs are calculated for each receptor–$COPC_E$ pair using a NOAEL for the $COPC_E$ to derive the HQ_N, and a LOAEL to derive the HQ_L. Although the TCRA is not considered part of the baseline condition, post-TCRA risks are examined to allow consideration of the TCRA in the evaluation of remedial alternatives in the FS. Background ecological risks are characterized to describe the incremental risks due to exposures within the area of USEPA's Preliminary Site Perimeter that is being addressed.

Ecological risk assessments are inherently uncertain, as they incorporate a wide range of assumptions in order to attempt to model a variable and complex natural environment. While some compensation can be made to account for uncertainty by using conservative assumptions, a baseline ecological risk assessment should incorporate realism whenever possible to effectively inform risk management. Therefore, not all uncertainties can be addressed by conservatism. Uncertainties discussed in detail in the BERA for the area north of I-10 and aquatic environment include:

- Data gaps and limitations
- Model uncertainty, and specifically the use of models to predict chemical concentrations in several media types
- Uncertainty in toxicity information.

Risks to Benthic Invertebrates

A conservative assessment of risks to benthic invertebrates indicates no risks to the assessment endpoint of the abundance and diversity of benthic macroinvertebrate communities from exposure to BEHP, phenol, cobalt, copper, lead, thallium, and zinc (Table 6-1 [from the BERA]). Carbazole and aluminum concentrations in surface sediments of the Site are not greater than in background areas, and risks associated with these metals are therefore not greater than background risks. Barium and vanadium, for which information on toxicity to benthic macroinvertebrates is lacking, and manganese are randomly distributed in sediments, and therefore appear not to be associated with the source material in the impoundments. Concentrations of mercury exceed a conservative SQG in two locations, but these exceedances do not equate to a prediction of effects. If effects exist at these two locations, the affected areas are isolated and small, and do not adversely affect the assessment endpoint, abundance and diversity of the overall benthic macroinvertebrate community.

Concentrations of TCDD in sediment exceed the NOAEL in only two locations, within the original impoundment perimeter, but there were no studies identifying benthic invertebrate LOAELs for dioxins and furans in sediment. NOAEL values as high as 25,000 ng/kg have been reported, suggesting that concentrations of TCDD in sediments are not sufficiently high to negatively impact the benthic macroinvertebrate community.

Clam tissue concentrations of TCDD are sufficiently elevated in samples collected directly adjacent to the impoundments to indicate reproductive risks to individual molluscs in that

area (Table 6-2 [from the BERA]). Concentrations of TCDD in clam tissue from two of five samples at Transect 5, directly adjacent to the upland sand separation area, exceed a threshold of reproductive effects in individual oysters. These localized effects do not adversely affect the assessment endpoint, stable or increasing populations of bivalves within the Site, because the affected area is limited to the immediate vicinity of the impoundments north of I-10.

Risks to Fish

Assessment of baseline risks to fish considered the concentrations of cadmium, copper, mercury, and zinc in the diets of fish (Table 6-3 [from BERA]), the concentrations of BEHP and nickel in water (Table 6-4 [from BERA]), and the concentrations of total PCBs, $TEQ_{DF,F}$, $TEQ_{P,F}$, and $TEQ_{DFP,F}$ in whole fish (Tables 4-5 and 4-6 [from BERA already listed above]). Results indicate that baseline risks to the assessment endpoint, stable or increasing populations of benthic omnivorous fish, benthic invertivorous fish, and benthic piscivorous fish on the Site are negligible.

Risks to Birds

Baseline risks to the assessment endpoint of stable or increasing populations of great blue heron and neotropic cormorant, and the birds in their feeding guilds that are represented by these receptor surrogates and that could use the Site are negligible. Exceedance of the egg tissue based NOAEC for great blue heron and cormorant ingesting prey and sediment at the Site are noted, but do not indicate risk to the assessment endpoints for piscivorous birds (Table 6-6 [from BERA]). Baseline risks to terrestrial invertivorous birds such as the killdeer are also negligible for all $COPC_{ES}$ except zinc and dioxins and furans. Baseline risks to spotted sandpiper and similar shorebirds, which ingest substantial amounts of sediment as a result of their foraging habit, are negligible for all $COPC_{ES}$ except for dioxins and furans (Table 6-5 [from BERA]).

There is a low probability (8.3 percent) that exposures of individual killdeer to zinc could exceed levels affecting reproduction, indicating negligible risk to the assessment endpoint of stable or increasing populations of terrestrial invertivorous birds. Uncertainties about the bioavailability of zinc from site soils, and of the form of this metal in foods and soils on the Site relative to the form used in toxicity tests result in a conservative bias in the risk assessment for zinc in killdeer. Exposures of killdeer to zinc on the Site are only slightly greater than exposures in background areas (Table 6-8 [from BERA]). There is also a low probability (4.7 percent) that exposures of individual killdeer to $TEQ_{DF,B}$ could exceed the LOAEL at the Site. Overall, risks to terrestrial invertivorous bird populations on the Site from zinc are very low to negligible.

There is a probability of 13.7 percent that exposure of individual spotted sandpipers and the species it represents to dioxins and furans exceeds exposures associated with reproductive effects in individual birds under baseline (pre-TCRA) conditions. Although probability of this exposure level was only calculated using the ingestion rate of birds, results of the modeling to estimate egg concentrations also indicate some baseline risk of reproductive effects from dioxins and furans in the spotted sandpiper. Among all vertebrate ecological receptors for this risk assessment, the sandpiper ingests the largest amount of sediment (per unit body weight), which is the most important source of their exposure. Implementation of the TCRA reduced risk to spotted sandpiper to negligible (Table 6-7 [from BERA]).

A comparison of TEQ HQs for birds with and without the bioavailability adjustment is provided in Table 7-2 [from BERA]. Table 7-3 [from BERA] compares TEQ HQs for the spotted sandpiper and killdeer with and without bioavailability adjustment and pre- and post-TCRA.

Risks to Mammals

Baseline risks to raccoon and mammals in the same feeding guild as the raccoon that could use the Site are negligible. There is negligible risk to the assessment endpoint of stable or increasing populations of omnivorous mammals from any $COPC_E$. Baseline risks to the marsh rice rat, representative of aquatic mammals, are also negligible for all $COPC_E$s except dioxins and furans (Table 6-9 [from BERA]). There is a 14.3 percent probability that an individual marsh rice rat using the Site under baseline conditions could be exposed to $TEQ_{DFP,M}$ at levels exceeding those associated with reproductive effects on mammals. Given the spatial bias in the dataset towards areas containing the most contaminated sediment on the Site, and given that these rodents can rear more than one litter each year, and that the probability of exposure at the effects level is low, baseline risks to the assessment endpoint of stable or increasing populations of omnivorous mammals on the Site as a whole are negligible. Implementation of the TCRA eliminated risks to the marsh rice rat and the mammals it represents.

Risks to Reptiles

There is insufficient information on the toxicity of $COPC_E$s to specifically address risks to the assessment endpoint of stable or increasing populations of reptiles using the Site. Although there are substantial uncertainties about dermal absorption of $COPC_E$s, in addition to uncertainties about toxicity, comparison of the alligator snapping turtle's ingested doses with those of bird and mammal receptors indicates that exposure potential of reptiles via ingestion is very low. For this reason, and because risks to $COPC_E$s other than dioxins and furans are low for some but more often negligible for these other receptors, risks to reptiles to $COPC_E$s other than dioxins and furans are also considered to be low. However, risks to reptiles living in close association with the former waste impoundments from exposure to dioxins and furans could exist under baseline conditions, because risks to spotted sandpiper and marsh rice rat are present, and because reptiles may be more susceptible to dermal uptake of dioxins and furans, increasing their exposure over estimates presented herein. Similarly, because implementation of the TCRA resolves risks to sandpiper and marsh rice rat, any risk to reptiles, if present, would be similarly reduced. Risks to reptiles from exposure to dioxins and furans are unknown.

Conclusions

Baseline risks to benthic macroinvertebrate communities and populations of fish, birds, mammals, and reptiles resulting from the presence of metals, BEHP, PCBs, carbazole, and phenol on the Site are negligible. Risks to fish populations from all $COPC_E$s are negligible. There are negligible risks to populations of wading birds represented by the great blue heron, and to populations of diving birds like the neotropic cormorant. There are negligible risks to populations of terrestrial mammals such as the raccoon.

There are low to negligible risks to individual terrestrial invertivorous birds like the killdeer

from exposure to zinc, and negligible risks to populations of such birds. Although the upper bound of estimated daily intakes of zinc by individual killdeer is about equal to conservative effects thresholds, the exposure estimate is influenced by the use of generic models to estimate zinc concentrations in the foods of the killdeer, and this model likely overestimates ingested tissue concentrations, resulting in overestimates of exposure and risk. The highest exposures of killdeer to zinc occur outside of the northern impoundment perimeter, and background exposures less than 30 percent lower than on the Site. In addition, the low probability of individual exposures exceeding effects levels indicates low risk to populations. There are also low to negligible risks to individual terrestrial invertivorous birds from exposure to dioxins and furans.

Baseline risks to ecological receptors associated with the wastes in the impoundments north of I-10 are the result of exposures to dioxins and furans localized to the immediate vicinity of the impoundments. Baseline ecological risks include reproductive risks to molluscs from exposure to TCDD, but primarily in the area of Transect 3, which surrounds the former waste impoundments, and low risks of reproductive effects in individual molluscs in sediments adjacent to the upland sand separation area, but not to populations of molluscs. Baseline risks include moderate risks to individual birds like the killdeer or spotted sandpiper whose foraging area could regularly include the shoreline adjacent to the impoundments north of I-10, but low risk to populations because of the low to moderate probability that individual exposures reach effects levels. Baseline risks include risks to individual small mammals with home ranges that include areas adjacent to the impoundments such as the marsh rice rat, but low to negligible risks to small mammal populations because of the moderate probability that exposures will reach levels associated with reproductive effects in individuals, and because small mammals reproduce rapidly.

To the extent that risks from chemicals other than dioxins and furans occur on the Site, they are not associated solely with hazardous substances that may have been released from the wastes in the former impoundments. Substantial exposure of killdeer to zinc, and a variable fraction of the exposures of several receptors to PCBs, occur in background areas.

Implementation of the TCRA has reduced individual and population-level risks associated with dioxins and furans to negligible, but does not affect risks to killdeer from zinc, suggesting that the wastes in the northern impoundments are not the primary source of exposures of killdeer to zinc. Results of the evaluation of post-TCRA ecological risks support the conclusion that localized exposures of ecological receptors to the wastes in the northern impoundments is the primary driver of baseline ecological risk at the Site, and that therefore risks are localized, resulting from direct contact with the wastes in the northern impoundments.